

WHAT IS CLAIMED IS:

1. A method of producing a silicon carbide single crystal comprising:

5 storing a sublimation law material on a first end portion in a reaction container;

 disposing a seed crystal of a silicon carbide single crystal on a second end portion substantially facing the sublimation law material in the reaction container; and

10 re-crystallizing the sublimated sublimation law material on the seed crystal to grow a silicon carbide single crystal,

 wherein a sealing portion is provided in the reaction container to grow a silicon carbide single crystal on the seed crystal provided in the sealing portion while preventing the
15 leak of the sublimated sublimation law material from the atmosphere for sublimation.

2. The method of producing a silicon carbide single crystal according to claim 1, wherein the thermal expansion coefficient
20 of the sealing portion is substantially the same as that of the seed crystal.

3. The method of producing a silicon carbide single crystal according to claim 2, wherein the material of the sealing portion
25 is a graphite.

4. The method of producing a silicon carbide single crystal

according to any of claims 1 to 3, wherein the sealing portion is for covering the single crystal growth possible region in the atmosphere for sublimation.

- 5 5. The method of producing a silicon carbide single crystal according to any of claims 1 to 4, comprising

growing the silicon carbide single crystal while maintaining the whole growing surface in a convex shape throughout all growth processes.

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6. The method of producing a silicon carbide single crystal according to any of claims 1 to 5, comprising

growing the silicon carbide single crystal while the entire surface excluding the growth surface contacts the sealing
15 portion throughout all growth processes.

7. The method of producing a silicon carbide single crystal according to claim 5,

wherein a crystal of silicon carbide containing a silicon
20 carbide single crystal is grown approximately in a protruded shape.

8. The method of producing a silicon carbide single crystal according to claim 5, comprising

25 growing the crystal of silicon carbide containing a silicon carbide single crystal while maintaining the approximate protruded shape and,

wherein the diameter of the crystal of silicon carbide decreases gradually toward the sublimation raw material throughout all the growth processes.

- 5 9. The method of producing a silicon carbide single crystal according to any of claims 1 to 8, comprising

growing the silicon carbide single crystal only in regions of the second end portion excluding parts adjacent to the peripheral wall surface portion of the reaction container.

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10. The method of producing a silicon carbide single crystal according to any of claims 6 to 9,

wherein the crystal of silicon carbide containing a silicon carbide single crystal is composed only of a silicon carbide
15 single crystal.

11. The method of producing a silicon carbide single crystal according to any of claims 5 to 10, comprising:

storing a sublimation raw material on the first end portion
20 side in the reaction container;

disposing a seed crystal for a silicon carbide single crystal on the second end portion side in the reaction container;

forming the sublimation atmosphere so as to enable sublimation of the sublimation raw material by a first heating
25 means disposed on the first end portion side; and

forming the re-crystallization atmosphere such that the sublimation raw material sublimated by the first heating means

is re-crystallized only in the vicinity of the seed crystal of the silicon carbide single crystal by a second heating means disposed on the second end portion side so as to re-crystallize the sublimation law material on the seed crystal of the silicon carbide single crystal.

12. The method of producing a silicon carbide single crystal according to claim 11,

wherein the temperature of the re-crystallization atmosphere is lower than the temperature of the sublimation atmosphere by 30 to 300°C, in the reaction container.

13. The method of producing a silicon carbide single crystal according to claim 11 or 12,

wherein the first heating means and the second heating means are an induction-heatable coil.

14. The method of producing a silicon carbide single crystal according to claim 13,

wherein the current value of the induction heating current in the first heating means is larger than the current value of the induction heating current in the second heating means.

15. The method of producing a silicon carbide single crystal according to claim 13 or 14,

wherein the current value of the induction heating current in the second heating means is decreased continuously or

gradually with the increase of the diameter of a growing silicon carbide single crystal.

16. The method of producing a silicon carbide single crystal
5 according to any of claims 11 to 15,

wherein if the temperature at one end side accommodating
a sublimation raw material is represented by T_1 and the
temperature at another end side at which a seed crystal of a
silicon carbide single crystal is placed is represented by T_2 ,
10 in the reaction container, and the temperature of the part
adjacent to the inner peripheral side surface part of the
reaction container at said another end side is represented by
 T_3 , then, $T_3 - T_2$ and $T_1 - T_2$ increase continuously or gradually.

15 17. The method of producing a silicon carbide single crystal
according to any of claims 13 to 16,

wherein an interference preventing means capable of flowing
the induction current and preventing interference between the
first heating means and the second heating means by flowing
20 the induction current is placed between the first heating means
and the second heating means.

18. The method of producing a silicon carbide single crystal
according to claim 17, wherein the interference preventing means
25 is a coil through which cooling water can flow.

19. The method of producing a silicon carbide single crystal

according to any of claims 11 to 18, wherein the one end is a lower end and another end is an upper end.

20. The method of producing a silicon carbide single crystal
5 according to any of claims 11 to 19, wherein the reaction container is a crucible placed in a quartz tube.

21. The method of producing a silicon carbide single crystal according to any of claims 11 to 20, wherein an inner side region
10 adjacent to the region for carrying out the silicon carbide single crystal growth in the second end portion and an outer side region on the outer circumference of the inner side region are provided as independent members such that one end of the member forming the inner side region is contacted with a sealing
15 portion provided in the reaction container and the other end is exposed to the outside of the reaction container.

22. The method of producing a silicon carbide single crystal according to any of claims 1 to 21, wherein the surface of the
20 part adjacent to the peripheral side surface part in the reaction container at another end is made of glassy carbon.

23. The method of producing a silicon carbide single crystal according to any of claims 5 to 22, wherein the sublimation
25 raw material is a silicon carbide powder obtained by using as a silicon source at least one compound selected from high purity alkoxysilanes and alkoxysilane polymers, as

a carbon source a high purity organic compound generating carbon by heating;

uniformly mixing the silicon source and the carbon source to obtain a mixture; and

5 calcinating the resulted mixture by heating under a non-oxidizing atmosphere.

24.The method of producing a silicon carbide single crystal according to any of claims 5 to 22, wherein the sublimation
10 raw material is a silicon carbide powder obtained by

using as a silicon source a high purity alkoxysilane, as a carbon source a high purity organic compound generating carbon by heating;

uniformly mixing the silicon source and the carbon source
15 to obtain a mixture; and

calcinating the resulted mixture by heating under a non-oxidizing atmosphere.

25.The method of producing a silicon carbide single crystal
20 according to any of claims 5 to 22, wherein the sublimation raw material is a silicon carbide powder obtained by

using as a silicon source at least one of a high purity alkoxysilane and a polymer of a high purity alkoxysilane, as a carbon source a high purity organic compound generating carbon
25 by heating;

uniformly mixing the silicon source and the carbon source to obtain a mixture; and

calcinating the resulted mixture by heating under a non-oxidizing atmosphere.

26. The method of producing a silicon carbide single crystal
5 according to any of claims 5 to 22, wherein the sublimation raw material is a silicon carbide powder obtained by

using as a silicon source at least one compound selected from the group consisting of high purity methoxysilane, high purity ethoxysilane, high purity propoxysilane and high purity
10 butoxysilane, as a carbon source a high purity organic compound generating carbon by heating;

uniformly mixing the silicon source and the carbon source to obtain a mixture; and

calcinating the resulted mixture by heating under a
15 non-oxidizing atmosphere.

27. The method of producing a silicon carbide single crystal according to any of claims 5 to 22, wherein the sublimation raw material is a silicon carbide powder obtained by

20 using as a silicon source at least one compound selected from the group consisting of high purity methoxysilane, high purity ethoxysilane, high purity propoxysilane and high purity butoxysilane, and a polymer of them having a polymerization degree of 2 to 15, as a carbon source a high purity organic
25 compound generating carbon by heating;

uniformly mixing the silicon source and the carbon source to obtain a mixture, and calcinating the resulted mixture by

heating under a non-oxidizing atmosphere.

28. The method of producing a silicon carbide single crystal according to any of claims 5 to 22, wherein the sublimation
5 raw material is a silicon carbide powder obtained by

using as a silicon source at least one of compound selected from the group consisting of high purity monoalkoxysilanes, high purity dialkoxysilanes, high purity trialkoxysilanes and high purity tetraalkoxysilanes, and a polymer of them having
10 a polymerization degree of 2 to 15, as a carbon source a high purity organic compound generating carbon by heating;

uniformly mixing the silicon source and the carbon source to obtain a mixture; and

calcinating the resulted mixture by heating under a
15 non-oxidizing atmosphere.

29. The method of producing a silicon carbide single crystal according to any of claims 23 to 28, wherein the silicon source is a tetraalkoxysilane polymer and the carbon source is a phenol
20 resin.

30. The method of producing a silicon carbide single crystal according to any of claims 23 to 29, wherein each content of impurity elements in the silicon carbide powder is 0.5 ppm or
25 less.

31. A silicon carbide single crystal produced by the method of

producing a silicon carbide single crystal according to any of claims 5 to 30.

32. The silicon carbide single crystal according to claim
5 31, wherein the crystal defect in the form of hollow pipe of which image is optically detected is $100/\text{cm}^2$ or less.

33. The silicon carbide single crystal according to claim 31
10 or 32, wherein the total content of impurity elements is 10 ppm or less.

34. A silicon carbide single crystal production apparatus,
comprising at least a crucible having a reaction container main
body capable of storing a sublimation law material; a lid portion
15 provided detachably to the reaction container main body; and
a sealing portion having substantially the same thermal
expansion coefficient as that of the seed crystal, capable of
placing a silicon carbide single crystal, for preventing the
leak of the sublimated sublimation law material.

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35. The silicon carbide single crystal production apparatus
according to claim 34, wherein the sealing portion comprises
a bottom portion having a first surface to substantially face
to the sublimation law material for allowing the installation
25 of the seed crystal at the time of being provided on the reaction
container main body and a second surface facing the lid portion,
and a wall portion provided upright from the rim portion

circumference of the first surface of the bottom portion so as to form the hollow portion together with the first surface of the bottom portion, such that the single crystal growth possible region of the circumferential side portion of the reaction container is covered at the time the first surface of the bottom portion is provided in the reaction container substantially facing the sublimation law material.

36. The silicon carbide single crystal production apparatus according to claim 35, wherein the material of the sealing portion is a graphite.

37. The silicon carbide single crystal production apparatus according to any of claims 34 to 36, further comprising:

15 a first induction heating coil disposed in a spirally wound state on the outer circumference of the portion for storing the sublimation law material in the crucible for forming the atmosphere for sublimation for allowing sublimation of the sublimation law material; and

20 a second induction heating coil disposed in a spirally wound state on the outer circumference of the portion for storing the seed crystal in the crucible for forming the re-crystallization atmosphere for re-crystallization for allowing the re-crystallization of the sublimation law material
25 sublimated by the first induction heating coil only in the vicinity of the seed crystal of the silicon carbide single crystal to re-crystallize the sublimation law material on the

seed crystal of the silicon carbide single crystal.

38. The silicon carbide single crystal production apparatus according to claim 37, wherein an interference preventing means
5 is disposed between the first heating means and the second heating means, capable of supplying an induction electric current and preventing the interference between the first induction heating means and the second induction heating means by supplying the induction electric current.

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39. The silicon carbide single crystal production apparatus according to claim 38, wherein the interference preventing coil is a coil allowing passage of the cooling water.

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